WHAT IS CLAIMED IS:

1. A position detection apparatus for detecting a position of a mark similar to a template image from an input image, comprising:

phase difference calculation means for calculating phase component difference between phase component of each frequency component of the template image transformed into frequency components with a reference point being set at a predetermined point on the template image, and a phase component of each frequency component of the input image transformed into frequency components with a reference point being set at a predetermined point on the input image; and

mark position detection means for transforming the phase component difference calculated by said phase difference calculation means into phase impulse response function, and for detecting a position of the mark on the input image based on the phase impulse response function.

2. A position detection method for detecting a position of a mark similar to a template image from an input image, comprising steps of:

calculating phase component difference between phase component of each frequency component of the template image transformed into frequency components with a reference point being set at a predetermined point on the template image, and a phase component of each frequency component of the input image transformed into frequency components with a reference point being set at a predetermined point on the input image; and

detecting a position of the mark on the input image based on the phase impulse response function, said mark position detection step comprising a step of transforming the phase

component difference into phase impulse response function.

3. The position detection method as claimed in claim 2, wherein the phase component difference is calculated in said phase component difference calculation step based on frequency response function of the input image relative to the template image.

4. The position detection method as claimed in claims 2, wherein said mark position detection step comprises a step of detecting coordinates, which give a value of phase impulse response function satisfying a predetermined condition, from the input image, and

the position of the mark is detected based on the detected coordinates.

5. The position detection method as claimed in claim 4, wherein coordinates, of which absolute value of difference between the value of phase impulse response function and a predetermined value takes the maximum, are detected in said coordinates detection step.

6. The position detection method as claimed in claim 4, wherein coordinates, of which the value of the phase impulse response function takes a local extremum, are detected in said coordinates detection step.

7. The position detection method as claimed in claim 2, further comprising a step of transforming the input image into the frequency components.

8. The position detection method as claimed in claim 7, further comprising a step of selecting a comparison area, of which the

size is substantially the same as that of the template image, from the input image, wherein

the comparison area is transformed into the frequency components in said transformation step with a reference point on the input image being set at coordinates on the comparison area corresponding to the predetermined position set as the reference point on the template image.

9. The position detection method as claimed in claim 8, further comprising a step of dividing the input image into preliminary areas, each of which the size is smaller than that of the template image, wherein

the comparison area is selected in said comparison area selection step so that each of the preliminary areas may be included in predetermined positions, respectively.

10. The position detection method as claimed in claim 8, further comprising a step of correcting pixel values of the comparison area so that pixel values at edges of the comparison area may become substantially equal to one another.

11. The position detection method as claimed in claim 8, wherein

said mark position detection step further comprises a step of detecting the comparison area including the coordinates which give the value of the phase impulse response function satisfying a predetermined condition based on the phase impulse response function converted from the phase component difference, wherein

the position of the mark is detected based on the position of the comparison area in the input image and the coordinates in the comparison area.

12. The position detection method as claimed in claim 8, wherein said mark position detection step further comprises steps of:

selecting a predetermined area from the comparison area;

extracting values of phase impulse response function in the predetermined area; and

selecting a value of the phase impulse response function, which satisfies a predetermined condition, from the extracted phase impulse response function values, wherein

coordinates which give the selected phase impulse response function value are detected in said mark position detection step.

13. The position detection method as claimed in claim 8, wherein said mark position detection step comprises a step of judging whether the mark is included in the comparison area by comparing the value of the phase impulse response function in the comparison area with a predetermined threshold based on the phase impulse response function which is transformed from the phase component difference of the comparison area.

14. The position detection method as claimed in claim 2, further comprising a step of extracting the phase component of a predetermined frequency component, wherein

the position of the mark on the input image is detected in said mark position detection step based on the phase component difference between the phase component of the template image extracted in said band extraction step, and the phase component of the input image extracted in said band extraction step.

15. The position detection method as claimed in claim 2, further comprising a step of storing the phase component of each frequency component defined based on a value of amplitude of the frequency

component of the frequency-transformed template image in association with the frequency component, wherein

the phase component difference between the phase component of each frequency component corresponding to each of the frequency components stored in said template frequency storage step among the phase components of the frequency-transformed input image, and the phase component of each frequency component of the template image stored in said template frequency storage step, is calculated in said phase component difference calculation step.

16. The position detection method as claimed in claim 2, further comprising a step of storing the phase components of frequency-transformed template image in association with the frequency components.

17. The position detection method as claimed in claim 2, further comprising a step of correcting pixel values of the template image so that pixel values at edges of the template image may become substantially equal to one another.

18. The position detection method as claimed in claim 2, further comprising steps of:

storing a template reciprocal image having reciprocal frequency characteristic of the template image;

generating a convolution integral image of the template reciprocal image and the input image; and

transforming the convolution integral image into frequency components with a reference point being set at a predetermined point, wherein

a phase component of the convolution integral image with a reference point being set at a predetermined point on the

convolution integral image is calculated as the phase component difference in said phase component difference calculation step.

19. The position detection method as claimed in claim 18, further comprising steps of:

transforming the template image into frequency components by two-dimensional discrete Fourier transform; and

generating the template reciprocal image by calculating reciprocals of the frequency components of the transformed template image and by transforming the reciprocals by two-dimensional discrete Fourier transform.

20. An electron beam exposure apparatus for exposing a pattern on a wafer by an electron beam, comprising:

an electron beam generating section for generating the electron beam;

a wafer stage mounting thereon the wafer;

input image imaging means for imaging an image of a mark as an input image, the mark being provided on either the wafer or the wafer stage, and being similar to a template image for detecting a position of a wafer; and

a position detection apparatus for detecting the position of the mark from the input image, wherein

said position detection apparatus comprises:

phase difference calculation means for calculating phase component difference between phase component of each frequency component of the template image transformed into frequency components with a reference point being set at a predetermined point on the template image, and a phase component of each frequency component of the input image transformed into frequency components with a reference point being set at a predetermined point on the

input image; and

a mark position detection means for detecting the position of the mark on the input image based on phase impulse response function which is transformed from the phase component difference calculated by said phase difference calculation means.